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SOUTHWEST FISHERIES CENTER

MONTHLY REPORT-APRIL 1984

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SOUTHWEST FISHERIES CENTER
MONTHLY REPORT - APRIL 1984

Status of Publications

Published

Alheit, J., B. Alegre, V.H. Alarcón, and B. Macewicz. 1983. Batch fecundity and spawning frequency of various anchovy (Genus: Engraulis) populations from upwelling areas and their use for spawning biomass estimates. In: G.D. Sharp and J. Csirke (eds.), Proceedings of the Expert Consultation to examine changes in abundance and species of neritic fish resources. San Jose, Costa Rica, 18-29, April 1983. FAO Fish. Rep. (291) 3:977-985.

Bakun, A. 1983. Report of the working group on environmental studies and monitoring. In: J. Csirke and G.D. Sharp (eds.), Proceedings of the Expert Consultation to examine changes in abundance and species of neritic fish resources. San Jose, Costa Rica, 18-29 April 1983. FAO Fish. Rep. (291) 1:41-54.

Gomez, Edgardo D., and George H. Balazs. 1983. Marine turtle stamps - promoting conservation. Newsl. Chel. Doc. Cent. 2(2-4): 15-22.

MacCall, Alec D. 1983. Variability of pelagic fish stocks off California. 101-112 pp. In: G.D. Sharp and J. Csirke (eds.), Proceedings of the Expert Consultation to Examine Changes in Abundance and Species Composition of Neritic Fish Resources. San Jose, Costa Rica, 18-29 April 1983. FAO Fish. Rep. 291(2): 101-112. pp.

California coastal pelagic fish stocks show a variety of patterns of fluctuations. Pacific sardines have been drastically reduced by excessive fishing pressure, and have been slow to recover. Both California and Mexico have developed reduction fisheries for

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the anchovy, and the stock is now fully exploited. Pacific mackerel were depleted by the mid-1960's, but have been fully rehabilitated due to favorable recruitment and a strictly controlled harvest, and now support a healthy fishery. Jack mackerel is a large resource, but is unexploited except for a small fishery on young fish on the nursery ground off southern California. The Pacific bonito is a marginal population which recently established itself off southern California, and its performance is questionable. The barracuda stock also is at low abundance, but the size composition has responded favorably to a size limit imposed in the early 1970's. Status of the white seabass is unclear, but the resource is probably overexploited.

MacCall, A.D. 1983. Report of the working group on resources study and monitoring. In: J. Csirke and G.D. Sharp (eds.), Proceedings of the Expert Consultation to examine changes in abundance and species of neritic fish resources. San Jose, Costa Rica, 18-29 April 1983. FAO Fish. Rep. (291) 1:9-39.

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Smith, P.E., H. Santander, and J. Alheit. 1983. Comparison of egg sample probability distributions of the anchovy (Engraulis ringens) and sardine (Sardinops sagax) off Peru and the anchovy (E. mordax) and the sardine (Sardinops caerulea) off California. In: G.D. Sharp and J. Csirke (eds.), Proceedings of the Expert Consultationto examine changes in abundance and species of neritic fish resources. San Jose, Costa Rica, 18-29 April 1983. FAO Fish. Rep. (291) 3: 1027-1038.

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Fiedler, Paul C., Gary B. Smith, and R. Michael Laurs. Fisheries applications of satellite data in the eastern North Pacific. For consideration for publication in Mar. Fish. Rev..

Gerrodette, Tim. Dynamic response analysis. II. Evaluation of dynamic response analysis in a simulated no-harvest case. Fish. Bull., U.S.

Henderson, John R. Encounters of Hawaiian monk seals with fishing gear at Lisianski Island, 1982. Mar. Fish. Rev.

MacCall, Alec D. Changes in the biomass of the California Current ecosystems. For publication in AAAS Symposium on Variability and Management of Large Marine Ecosystems.

Perrin, William F., Michael D. Scott, Jay Walker and Virginia L. Cass. Review of geographical stocks of tropical dolphins (Stenella spp. and Delphinus delphis) in the eastern Pacific. For publication in Fish. Bull., U.S.

Polovina, Jeffrey J. An overview of the ECOPATH model. ICLARM Fishbyte.

Sakagawa, Gary. Scientific findings of the International Skipjack Year Program (1979-1982). For publication in the 4th Week of Fisheries Volume.

Administrative Reports

Samples, Karl C., James N. Kusakabe, and John T. Sproul. 1984. A description and economic appraisal of charter boat fishing in Hawaii. SWFC Admin. Rep. H-84-6C, 130 p.

Translation:

Yamamoto, Shoichi, Kiyohiko Ishii, Seiji Sasaki, and Toshimi Meguro. 1978. Outlines of fisheries investigation on the Emperor Seamounts by the R/V Hokusei Maru in 1977 and some technical problems (1977-nen no Hokusei Maru ni yoru Tenno Kaizan chosa no gaiyo to hyoho no mondaiten). Bull. Jpn. Soc. Fish. Oceanogr. 33:56-64. (Engl. transl. by Tamio Otsu, 1984, 24 p., Transl. No. 91.)

HONOLULU LABORATORY

Insular Resources Investigation

Work Started to Determine Thermal Effects on Fishes

Dr. George W. Boehlert, Chief, Insular Resources Investigation, reports that research has begun on the assessment of possible thermal effects of proposed Ocean Thermal Energy Conservation (OTEC) operations on early life history stages of commercially important fishes. The study will concentrate on determining lethal and sublethal effects of lowered temperatures on eggs and larvae of mahimahi, and goldspot herring. The research, which is funded by NOAA's Ocean Minerals and Energy Division, will be conducted at the Kewalo Research Facility by fishery biologist Thomas K. Kazama and research assistant Yara Lamadrid-Rose.

Townsend Cromwell Completes Western Pacific Seamount Cruise

The NOAA Ship, Townsend Cromwell, returned to Guam after completing cruise 84-03 in waters around the Mariana Archipelago to assess the fishery resources of seamounts. Relatively poor catches were recorded on the seamounts when compared with catches on the reefs near the main islands. During the cruise, hydrographic surveys were conducted to construct bathymetric charts, and plankton samples and physical-chemical data of waters around seamounts were collected. Halfway through the cruise, the Cromwell made a port call at Shimizu, Japan, where several members of the scientific party presented papers at the informal workshop, "Environment and Resources of Seamounts in the North Pacific."

Preparations Made for Seamount Cruise

James H. Uchiyama, Fishery Biologist, began preparations for cruise TC-84-05 to the Hancock Seamounts. Details of the hydrographic transects, drogue observations, fish trawling, and biological sampling have been worked out with Dr. Boehlert. Uchiyama also discussed plans for the lobster pot escape vent experiment, which is scheduled early in the cruise at Necker Island, with Dr. Robert A. Skillman and research assistant Alan R. Everson. After discussions with fishery biologist Walter M. Matsumoto, squid jigging was scheduled during available times en route between Honolulu and Hancock Seamounts. Research assistant Bernard M. Ito has been assisting in gear preparation for the hydrographic portion of the cruise.

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Reginald M. Gooding, Fishery Biologist, prepared a report, "Submersible observations of deepwater shrimp, Heterocarpus ensifer, off the island of Hawaii," and revised a manuscript, "The effect of lobster offal on trap catches of spiny lobster, Panulirus marginatus, in the Northwestern Hawaiian Islands."

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James H. Uchiyama revised the following manuscripts: "Fishery atlas of the Northwestern Hawaiian Islands," "Growth of dolphin fishes, Coryphaena hippurus and C. equiselis, in Hawaiian waters as determined by daily increments on otoliths," and "Preliminary estimates on the age and growth of the spiny lobster, Panulirus marginatus, in the Northwestern Hawaiian Islands."

Otolith Data Analyzed

Dr. Stephen Ralston, Fishery Biologist, reports that research assistant Happy A. Williams has completed analysis of otoliths made available to the Resource Assessment Investigation of the Mariana Archipelago (RAIOMA) program by Andrew Richards of the Department of Primary Industry, Papua New Guinea. Using a sample of 31 otoliths obtained from 20 specimens of Pristipomoides multidens, Williams was able to measure the average width of daily increments and thus estimate the rate of otolith growth. The data were analyzed by Ralston using a program he developed which numerically integrates this kind of otolith data, estimates otolith size at age, transforms the data to fish size at age, and then fits the results to two versions of the standard von Bertalanffy growth model. Using size-frequency data, it is also possible to estimate the total mortality rate (Z) from the ratio of Z/K. The results show that this species has an instantaneous growth rate (K) of 0.18 per year and total instanteous mortality rate of about 0.60 per year.

Final RAIOMA Cruise Underway

Dr. Jeffrey J. Polovina, Leader, Resource Assessment Investigation of the Mariana Archipelago (RAIOMA) Program, traveled to Guam this month to board the Townsend Cromwell for the final RAIOMA cruise.

Sampling for bottom fishes and the deepwater caridean shrimp, Heterocarpus laevigatus, is the primary emphasis of these cruises. During the current cruise, an intensive fishing experiment for bottom fishes at Pathfinder Reef, a shallow seamount in the South Honshu Ridge, will be conducted. Preliminary reports from Polovina indicate very good initial catch rates at this site, and after eight days of fishing, the vessel had to depart

for Saipan to offload the catch. Pathfinder Reef is small (circumference approximately 3 miles) and is an ideal location for this type of study. If successful, results should complement the intensive fishing experiment performed on H. laevigatus at Alamagan Island during the preceding cruise. The Townsend Cromwell will return and resume fishing on Pathfinder Reef at a later date.

Fishery Management Research Program

Design Work Continues on Escape Vent Experiment

Dr. Robert A. Skillman, Leader, Fishery Management Research Program, reports that design work on the spiny lobster escape vent experiment is continuing. A preliminary experimental design was drafted and circulated for internal review, in response to the Western Pacific Regional Fishery Management Council's suggestion for using escape gaps to reduce the mortality attributed to handling sublegal spiny lobsters in the fishery. On the basis of information in the literature, estimates of sample size were computed based on probable levels of the percent reduction in catch of sublegal spiny lobsters. In addition, the statistical procedures to be followed in analyzing the data were expanded and modified according to reviewers' comments and information from the literature. A second draft of the project documentation was prepared and reviewed by the chairman of the Council's crustacean plan development team. Internal review of the second draft has also been solicited. Alan Everson has begun setting up the tank at the Kewalo Research Facility (KRF) for carrying out the laboratory components of the study.

Fishery Data Reformatted and Summarized

Heide Miller-Pakvasa, Computer Programmer, has completed converting detailed observer data from past commercial spiny lobster cruises to a format comparable to that in which data are now collected under the Spiny Lobster Fishery Management Plan. These data and others will be used in assessing the state of the stocks in the Northwestern Hawaiian Islands.

Research assistant Nathaniel T. Shippen completed a summary of the catch, effort, and CPUE of billfish, mahimahi, wahoo, and tuna caught in the 10° rectangle surrounding American Samoa by tuna longline vessels fishing out of Pago Pago. This summary was made at the request of the government of American Samoa for information on the seasonal variation of these fishes relative to development work the government is doing.

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David C. Hamm, Computer Systems Analyst, provided descriptions on the WPACFIN project and recommendations on implementing similar systems to John

Sibert, South Pacific Commission, Jerry Fagolimul, Yap Marine Resources Division, and K. Sivasubramaniam, FAO Bay of Bengal programme in Sri Lanka.

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Dr. Skillman conducted a program evaluation and review techniques session with Ray F. Sumida, Fishery Biologist, Samuel G. Pooley, Industry Economist, and Bernard Ito for a project to determine the annual take of pelagic management species in Hawaii. A list of potential wholesale fish dealers has been updated for the study.

Skillman also reports that a draft administrative report on Phase II of the vessel inventory has been completed. The study involved a mail survey to verify the public record, and the classification of vessels in Hawaii according to various fishery-related factors.

Pelagic Resources Investigation

Work Started on Proceedings of Seamount Workshop

Richard N. Uchida, Acting Chief, Pelagic Resources Investigation, reports that he has started preparing the proceedings of the "Workshop on the Environment and Resources of Seamounts in the North Pacific," which was held in Shimizu, Japan on March 21-23, 1984. The workshop was sponsored by the Honolulu Laboratory, the Far Seas Fisheries Research Laboratory (FSFRL) of Shimizu, Japan, and the Japanese Society of Fisheries Oceanography of Tokyo, Japan. Dr. Sigeiti Hayasi of the FSFRL and Uchida co-chaired the workshop, which was held at the Orido Community Center in Shimizu and at the Government Port Building (one afternoon session). The workshop was divided into six sessions: review of the oceanography in the vicinity of seamounts, review of seamount fisheries, review of other seamount fisheries, review of population characteristics and biology of seamount species, stock assessment, and development of hypotheses and models.

Five papers were prepared by Honolulu Laboratory staff and presented at the workshop: "Seamounts: A biological concourse in the open sea--An introductory statement" by Honolulu Laboratory Director Richard S. Shomura; "Review and present status of handline and bottom longline fisheries for alfonsin" by Michael P. Seki and Darryl T. Tagami; "Review and current status of research on the biology and ecology of pelagic armorhead" by Robert L. Humphreys, Jr. and Darryl T. Tagami; "Problems in assessing the pelagic armorhead stock on the central North Pacific seamounts" by Jerry A. Wetherall and Marian Y. Y. Yong; and "Seamounts resources: Hypotheses and future research directions" by George W. Boehlert.

Uchida began working on a workshop summary with Dr. Hayasi. All workshop papers, will eventually be published in both English and Japanese after the translations have been completed.

Study on Magnetic Compass Sense of Tunas Continues

Dr. Michael M. Walker received a grant from the University of Hawaii (UH) Sea Grant Program to continue his studies on the ability of tunas to navigate by detecting and using the earth's magnetic field. Walker and research assistant Gregory Weber have begun a series of experiments to test the ability of kawakawa, Euthynnus affinis, and skipjack tuna, Katsuwonus pelamis, to detect alterations in the earth's magnetic field. A large wooden tank has been constructed at the KRF for these studies, and experiments should begin shortly to determine the smallest changes in the earth's magnetic field that tunas can detect.

Tuna Tracking Report Presented at Meeting

Dr. Richard W. Brill, Leader, Experimental Ecology of Tunas Programs, reports that he made a presentation at the Pacific Congress on Marine Technology held April 24-27 in Honolulu on the tuna tracking study, which is being conducted by Program researchers and Dr. Kim Holland of the UH. "Use of ultrasonic telemetry to determine the short-term movements and residence times of tuna around fish aggregating devices," by Brill, Holland, and Lt. (jg) J. Scott Ferguson, was published in the conference proceedings.

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Dr. Brill completed the first draft of a manuscript on the effect of body size and acute temperature change on the standard metabolic rate of yellowfin tuna, Thunnus albacares, and kawakawa. In cooperation with Dr. Peter Hochachka of the University of British Columbia, additional experiments on acid-base regulation and lactate metabolism in tuna following strenuous exercise are also being planned for this summer. This series of experiments will involve visits from eight scientists from five different universities.

Female Mahimahi Continues to Spawn at Kewalo Research Facility

Thomas Kazama reports that a new male mahimahi, Coryphaena hippurus, which was obtained during the month, began fertilizing the eggs of the female which has been held at the KRF for some time. The female has been spawning regularly every other day. In addition to being used in experiments on the effect of diet on the survival and growth of mahimahi larvae, the mahimahi eggs and larvae are being used by researchers in the Insular Resources Investigation to study the effects of cold water on the eggs and larvae. The latter study will allow the researchers to predict the potential effects of the cold water effluent of OTEC plants on pelagic fishes.

LA JOLLA LABORATORY

Coastal Fisheries Resources Division

Ecology and Taxonomy of Fishes

Results of Anchovy Egg Production Spawning Biomass Survey Processed

The samples from this year's anchovy egg production cruise (CalCOFI Cruise 8403) were processed during the month. A total of 937 samples, taken with the CalVET net, was examined and eggs from 349 positive hauls were staged. Numbers of eggs per sample ranged from 1 to 382. All data was entered on the computer and data sheets were turned over to Dr. Roger Hewitt for the age determination procedure. The chapter on egg staging for the Egg Production Technique Handbook was completed this month by authors H. G. Moser and E. H. Ahlstrom. The 11 stages assigned to the anchovy eggs are described in detail and key structural features are illustrated for each stage.

Data Entry of Historical CalCOFI Egg and Larva

Progress continues on the computer entry of the CalCOFI ichthyoplankton data set. Task members have been working closely with computer aid Ron Whyte who is coding and entering the data. The process has required examination of a large number of samples to clarify and update historical identifications. This has been facilitated by the recent reorganization, curation and archiving of the historical collection by fishery aid Victor Gorospe. It is now possible to quickly locate any historical egg and larva sample, an invaluable asset during the process of data entry.

Study on Food and Feeding of Fishes in the CalCOFI Region Completed

A manuscript on feeding of bocaccio (Sebastes paucispinis) larvae was completed this month by fishery biologists Barbara Sumida MacCall and H. G. Moser. The manuscript is part of a long-term study of feeding habits and structural characteristics of the digestive systems of fish in the California Current area. The first paper in this series on the Pacific hake (Merluccius productus) was published in CalCOFI Report 21. The present study summarizes data on stomach contents, mouth size, and feeding incidence of bocaccio larvae. The data are compared with corresponding data on Merluccius.

The composition of food in the diet of larval bocaccio (Sebastes paucispinis) and Pacific hake (Merluccius productus) overlapped in copepod types and developmental stages but noteworthy differences were evident from

gut content analyses of specimens collected in 1975 CalCOFI cruises. Compared to small hake larvae, early stages of bocaccio were euryphagous, that is, they ingested a greater diversity of food types including larval euphausiids, diatoms, dinoflagellates, tintinnids, and cladocerans. Copepod nauplii constituted the dominant prey type in bocaccio larvae less than 7.0 mm in body length with a total lack of adult copepods and very low incidence of copepodites. In contrast, adult copepods, primarily calanoids, made up a significant portion of the diet in all sizes of hake larvae examined, contributing ca. 74% of overall prey volume compared to ca. 33% in bocaccio larvae 7-13 mm in length.

Both bocaccio and Pacific hake larvae are large-mouthed species, but first-feeding bocaccio preyed on smaller organisms than first-feeding hake (30-170 μm wide vs. 40-350 μm in hake). Observations of feeding incidence in relation to time of capture suggested a faster rate of gut evacuation in bocaccio larvae.

Survey Systems Development and Evaluation

Schooling Coastal Pelagic Fish Recruitment Predicted

Dr. Paul Smith, Fishery Biologist, has assembled anchovy population vital rates for the purpose of establishing research goals for the development of recruitment predictions for schooling coastal pelagic fishes in general and the central population of the northern anchovy which inhabits the coastal area of Baja California Mexico and southern and central California. He used laboratory, field and population model data from survey and commercial catches, which had been analyzed by 13 SWFC authors in papers published over the past 15 years, to create a deterministic stationary model of the population.

Murphy (1966) suggested that a recruitment one-fifth of that expected for stationary populations might be considered disastrous. For the artificial anchovy population, Dr. Smith varied the fecundity parameter for the adult population and the mortality rates and durations of the embryonic (egg and yolk sac), early larva, and each of four 25 mm stages of growth (late larva, early and late juvenile and pre-recruit).

Based on past experience for estimating fecundity, no evidence of a five-fold change in either increased or decreased fecundity rate has been seen, though the actual fecundity has varied because of population changes of biomass. As shown in Table 1, population decreases may result from reasonable values of mortality rate in all age categories. Five-fold increases can only be accomplished singly by the mortality rates of embryos and early larvae and pre-recruits.

With regard to stage duration, reasonable values caused decreases in both stages of larvae and juveniles, although five-fold increases would not be possible in the juvenile stages. The embryonic stage duration alone would be relatively inflexible in its impact on recruitment.

Dr. Smith now plans to extend the deterministic phase of this work to habitat critical density work with Dr. John Hunter. Another extension may incorporate stochastic variations of the rates and durations, or, in a sense, expand from the sensitivity analysis originally suggested by Sette to a "robustness" of the population time series parameters. The ultimate phase will consider interactions among the parameters and population size and density. Hewitt (1982) has already detailed the interaction of population density and larval mortality rate, and Smith, Santander and Alheit (1983) have examined the embryonic mortality rate of Peruvian and California anchovy as a function of local population density.

CHANGES CAUSING A FIVE-FOLD DECREASE OR INCREASE IN RECRUITMENT OF NORTHERN ANCHOVY

STAGE	INSTANTANEOUS MORTALITY (DAILY)	STAGE DURATION (DAYS)	GROWTH RATE (mm/DAY)
EGG + YOLKSAC			
STATIONARY	0.250	8	-
1/5	0.454	14.5	-
5 X	0.048	1.6	-
EARLY LARVA (4-10mm)			
STATIONARY	0.160	12	0.500
1/5	0.297	22.2	0.270
5 X	0.026	1.9	3.158
LATE LARVA (10-35mm)			
STATIONARY	0.050	77	0.325
1/5	0.072	110	0.227
5 X	0.029	44.5	0.559
EARLY JUVENILE (35-60mm)			
STATIONARY	0.020	50	0.500
1/5	0.053	131	0.190
5 X	INF.	INF.	INF.
LATE JUVENILE (60-85mm)			
STATIONARY	0.010	71	0.350
1/5	0.033	232	0.108
5 X	INF.	INF.	INF.
PRE-RECRUIT (85-110mm)			
STATIONARY	0.010	287	0.087
1/5	0.016	449	0.056
5 X	0.0044	126	0.200

Dr. Smith Joins International Editorial Board

Dr. Paul E. Smith has accepted a position on the international review board for the South African Journal of Marine Science. This is a new journal combining the literature on the marine environment with the fundamental research on restoration and management of marine fisheries. The South African Sea Fisheries Institute, which publishes the journal, has been a world leader in assembling established series of multiple-species fisheries on schooling coastal pelagic fish pursued in the broad eastern boundary current region off Southwest Africa and the more dynamic upwelling region of the Cape fishery. The Institute also leads the world in integrating satellite spatial data with direct measurements of primary, secondary, and fishery productivity.

The Sea Fisheries Institute is now planning to add the Egg Production Method, developed by the Coastal Division scientists at the SWFC, to their multispecies monitoring by fishery analysis and acoustic surveys.

Commercial and Recreational Fisheries Research for Management

International Conference on Exploitation of Marine Communities Held in Berlin

Dr. Alec MacCall participated in a Dahlem Workshop on "Exploitation of Marine Communities" in Berlin, Germany from April 2 to 6, 1984. This workshop was supported by the Dahlem Konferenzen Foundation, the German "National Science Foundation" and the Senate of the City of Berlin, and was the 40th in a series assessing the state of knowledge in various subfields of medicine and the sciences. The goal of the workshop was to evaluate the ability of fishery science and management to deal with changes in the marine ecosystems. Participants included leading theoretical, traditional, and applied fishery ecologists, as well as experts from fields such as economics and political science. The workshop was divided into four working groups: 1) dynamics of single species, 2) ecosystems dynamics, 3) management under uncertainty, and 4) strategies for multispecies management. The reports of the working groups and a few excellent background review papers will be published later this year.

Following the Dahlem Workshop, MacCall traveled to the headquarters of the United Nations Food and Agriculture Organization (FAO) Rome, Italy. Fishery scientists at FAO are interested in the concept of a variable quota formula based on stock abundance as an alternative to the more commonly used effort-based systems. The quota formula has been used in California for management of the Pacific mackerel, and for the northern anchovy under the Fishery Management Plan developed by the Pacific Fishery Management Council. Effort-based policies can be included as special cases of quota formulas, but the quota formula approach allows a more flexible harvest policy that can treat a wider variety of objectives. Dr. MacCall is planning to collaborate with Drs. Jorge Csirke and Serge Garcia of FAO on a paper reviewing the general features and advantages of abundance-based quota formulas.

Paper Completed for Presentation at AAAS Symposium

Dr. Alec MacCall completed a paper titled, "Changes in the biomass of the California Current," for presentation at the annual meeting of the American Association for the Advancement of Science (AAAS) in New York City at the end of May. The paper will be presented during the symposium on Variability and Management of Large Marine Ecosystems. The paper reviews changes in abundance of major fishes, marine mammals, and seabirds in the California Current region. An unresolved puzzle is to identify the effect on the ecosystem of the loss of the Pacific sardine, which was a large intermediate component in the food web. Given the large natural variability in sardine abundance, it is

possible that the ecosystem is structured so that loss of the sardine is not as critical as might be supposed. However, most of our knowledge of the California Current has been gained since 1950, when the sardine had already become depleted. A future recovery of the sardine stock should provide a better opportunity to assess the role of the sardine, particularly if the sardine recovers suddenly. A sudden recovery would provide a good contrast among abundance levels.

Regulations of Dungeness Crab Fisheries Reviewed

Dr. Richard Methot, Fishery Biologist, has reviewed the regulations governing the Dungeness crab fisheries on the coasts of Washington, Oregon and California. The review has two major parts: one part examines the history of the fisheries and the rationales for the regulations in light of recent research, and the other part considers the current status of the crab fishery in relation to other major fisheries along the coast.

The crab fishery in the San Francisco area began in the mid 1800s and grew to the level of several million pounds during the period from 1880-1905. Near the end of this period a decline in stock abundance was perceived and several regulations were enacted. Landing female crab was prohibited; the season was closed during the major molting period; a size limit was imposed on male crabs that could be caught. These regulations did not reverse the stock's decline and the landings fell to less than 500,000 pounds by 1914 and did not recover to the previous levels until the late 1920s. Landings peaked in the late 1950s, and then collapsed to the level of the 1914-1925 period. Methot notes that recognition of the earlier collapse may aid research on the late 1950s collapse.

These regulations have been relatively unchanged and in reviewing the current crab fishery regulations, Methot agrees with other researchers that the prohibition on landing female crabs probably is unnecessary. Females are smaller than males and thus adequately protected by the size limit. Methot also notes that the size limit currently is set near the expected size of male crabs at their 14th molt. This limit may increase enforcement problems and lead to genetic selection for slower growing male crabs. Methot suggests that the size limit be lowered slightly to reduce these two problems and that available data is sufficient to determine the appropriate limit.

Currently, Dungeness crab is among the most valuable fisheries on the west coast north of Monterey. Other valuable fisheries are salmon, albacore, groundfish, shrimp and herring. Most of these fisheries are highly seasonal and multi-purpose vessels may routinely shift their effort between species within a season. Multi-purpose vessels also shift effort between seasons in response to natural fluctuations in the abundance of each of these species. These shifts in effort greatly complicate the study of the fishing fleet and determination of the appropriate size of the total fleet. In recent years the crab harvest has been good in northern California and many vessels have shifted into the crab fleet, causing a large fraction of the catch to be harvested in the first few weeks of the season. Although this may be an inefficient harvest of the crab resource, it may be reasonable when considered in the multi-species context.

Methot will present this review at the North Pacific Workshop on Invertebrate Stock Assessment and Management, May 7-10, Nanaimo, B.C., Canada.

Wetfish Fleet Analyzed

Dr. Dan Huppert and Cindy Thomson, Economists, worked on the wetfish fleet analysis in April. On the basis of data contained in the 1981 PACFIN Annual Summary File, Thomson used SPSS to compute landings by fishing area (San Pedro, Port Hueneme, Monterey) and species (anchovy, mackerel, bonito, bluefin, squid, herring) for wetfish vessels in various length classes. This information will be included in the annual status report for the anchovy fishery.

They also worked on the conversion of California pink ticket data to PACFIN format. Ms. Thomson is using FORTRAN programs written by John Davies to do the conversion. These programs include: PACFIN01.FOR, which identifies all pink ticket numbers with invalid California species, gear, port or origin codes and converts all valid species, gear, port, origin, condition, disposition and size codes to their PACFIN equivalents. Other programs include PACFIN02.FOR, which divides the file created by PACFIN01 into several subfiles; PACSRT02.JOB, which sorts each of the subfiles created by PACFIN02.FOR on CDF&G vessel ID, month/day landed and PACFIN species code; and PACMRG02.JOB, which merges the files created by PACSRT02.JOB and sorts the merged file on the same three elements.

After pre-testing these programs on the first 1000 records of the 1978 California pink ticket data file, Thomson ran these programs on the entire file (309,792 records altogether). She plans to do the same with 1979 data and to include landings information from both files in the annual status report for the anchovy fishery.

Progress Reports on Contract Studies of Pacific Coast Recreational Fishery Economic Values

During April, Dr. Huppert and Cindy Thomson also reviewed two progress reports on recreational economics studies. One was submitted by Energy and Resource Consultants, Inc. (ERCO) of Boulder, Colorado, and the other was a courtesy copy of a proposed survey of southern California anglers from Jones and Stokes Associates of Sacramento, California. The ERCO report is on preliminary estimates of travel-cost demand functions using the southern California portion of the 1981 NMFS socio-economic survey of marine anglers. These preliminary results are reasonably encouraging in that the effect of distance traveled on rates of participation is statistically significant even with the small sample sizes and imperfect variable definitions imposed by the socio-economic survey design. Further work by ERCO will include expansion of the geographic coverage to include the remainder of California and, eventually, the entire Pacific coast. This will involve using all the NMFS recreational survey data collected during 1979, 1980, and 1981.

The Jones and Stokes Associates survey objective is to collect all the information necessary for an economic evaluation of marine angling in southern California. With the assistance of two noted university research economists, Jones and Stokes intend to investigate various methods of determining the net economic value of fishing day and incremental fish catch to saltwater sportsfishermen. Comments on the proposed survey instrument and sample design were sent to Jones and Stokes by Huppert and Thomson.

Oceanic Fisheries Resources Division

Marine Mammal Biology

Soviet Scientist Visits SWFC for Joint Research

Dr. William Perrin, Fishery Biologist, reports that Dr. Mikhail V. Mina, Institute of Developmental Biology, Academy of Sciences, Moscow, USSR, visited the SWFC from March 26 to April 6. He worked with Dr. Perrin, Dr. Jay Barlow, Operations Research Analyst, and Jay Walker, Computer Programmer, on research to develop the use of non-metric skull characters to identify populations and subpopulations of pelagic dolphins involved in the purse-seine fishery for yellowfin tuna in the eastern tropical Pacific.

Non-metric characters are characters that are not measured, and include presence or absence of foramina or fenestrations, relative positions of foramina, and alternative shapes of fossae and processes. Such characters have been used recently with some success in delineating populations of rodents (e.g., see S.E. Harlan, 1980, "Geographic variation analysis of Dipodomys ordii using nonmetrical cranial traits," Journal of Mammalogy).

The project began in 1982, when Professor Alexey V. Yablokov of the Academy of Science visited the SWFC and worked with Perrin. Later the same year, Perrin went to Moscow to work with Yablokov and Mina. The initial work resulted in a paper published in a recent issue of Zoological Journal (Zoologicheskiy Zhurnal), "Evaluation of phenetic relations among groups of dolphins using analysis of non-metric cranial variation." During Dr. Mina's visit to the Center, he worked on cluster analysis of the data for individuals from five single-school samples, incorporating new characters developed by Yablokov in Moscow and new data collected by Perrin at the Smithsonian Institute last year. Mina and Walker developed and programmed a non-parametric, non-metric cluster-analysis method. Perrin and Mina computerized and edited the data. Barlow developed a simulation program for generating random data sets based on character-state frequencies in the real data. Most of the time available was spent in developing and comparing dendrograms for various permutations of samples and characters. The results suggested sample-correlated clustering, but the scientists agreed that problems may exist with repeatability of some of the characters. Tentative plans were made for further development of the cluster-analysis methods and for experiments on

reproducibility of the data. A narrative report on the two-week session is available from Perrin.

Marine Mammal Conference Held in La Paz, Mexico

Mark Lowry, Fishery Biologist, attended a conference on marine mammals in La Paz, Mexico, on March 28-31. The conference, which is an annual event, was sponsored by the Mexican Society for the Study of Marine Mammals (Sociedad Mexicana para el Estudio de los Mamiferos Marinos, A.C.). The conference gave researchers an opportunity to present results on their research and to meet with other researchers working with marine mammals in Mexico. Lowry attended the conference as the representative of the Southwest Fisheries Center.

Two reports on the California sea lion, Zalophus californianus, which pertain to work at the SWFC, were given at the conference. Carolyn Heath, graduate student from the University of California at Santa Cruz, described the adverse results which the El Niño oceanographic phenomena had on the sea lion population at San Nicolas Island, California. She reported that (1) the peak June population of 1983 was 37% lower than the 1982 June peak; (2) pup production in 1983 was lower than production in 1982 by 43% and pup mortality rose from 11% in 1982 to 17% in 1983; (3) the number of copulations in 1983 was down by approximately 50% from the 1982 level which may affect the number of pups born in 1984; and (4) the females who were nursing pups spent a significantly longer period at sea feeding than they did during 1982. Parts of Heath's study were sponsored by the SWFC. A second report presented by Francisco Sinsel of Centro de Investigaciones Biologicas (CIB) in La Paz, Mexico, gave results of a 3 year California sea lion pup mortality study. The results were obtained from pup tag-resight data for the cohorts of 1980, 1981, and 1982. Sinsel reported that there is an average 58% mortality rate during the pups' first year, with the greatest percentage of deaths occurring in the last six months.

Also of interest was a report given by Bruce Mate of Oregon State University on a satellite tracking device for use on large whales. The satellite tracking system is able to record the position of the whale, duration of dives and water temperature, and then transmit the data to the satellite as it orbits over the whale.

A workshop was held concerning the population of Gulf of California porpoise, Phocoena sinus, that inhabits the northern end of the Gulf of California. Researchers agreed that much work remains to be done to find out if any animals remain.

Photogrammetric Procedures Used to Investigate Growth Rates in Captive Dolphins

Aleta Hohn, Zoologist, reported that a bottlenose dolphin calf was born at the Naval Ocean Systems Center (NOSC) on April 16. Dr. Sam Ridgway, Director of Veterinary Research, NOSC, offered to let the staff members of the

Marine Mammal Biology Program document the growth of the newborn calf. Because the calf cannot be directly measured, Hohn, Jay Barlow, Marine Mammal Monitoring and Assessment Program, and Michael Scott, Inter-American Tropical Tuna Commission, have set up a stereo photogrammetric system for measuring its length once or twice each month for approximately a year. At the end of the year, direct measurements can be taken to determine if the photogrammetric system is accurately calibrated.

For the spotted dolphin life history and vital rate studies at the SWFC, a sample of approximately 1900 specimens were aged (see Monthly Report for May 1982). Results of an analysis of growth in the first year based on these age estimates (Hohn and Hammond, SWFC Admin. Rep.) suggested that these specimens were growing at a slower rate than captive bottlenose dolphins (Tursiops truncatus) because the wild dolphins were shorter than the captive dolphins at the end of the first year. The most likely explanations for this apparent discrepancy in growth rate are that newborn captive dolphins grow more quickly because they experience more optimum conditions (e.g., better nutrition for their mothers) than their wild counterparts, that the method used for age estimation underestimated the age of young specimens, or that spotted dolphin growth rates are different from bottlenose dolphin growth rates.

According to Hohn, there is little data available on growth rates of captive dolphins. The sample of young captive dolphins that have a known age and length is small. One reason is that dolphin keepers are reluctant to handle newborn and yearling dolphins for fear of decreasing their probability for survival. Thus, the opportunity to measure the calf at NOSC provides a unique opportunity to determine these growth rates.

Food Habits of Elephant Seals Studied at San Miguel Island, California

NMFS scientists from the Northwest and Alaska Fisheries Center and the Southwest Fisheries Center combined forces in carrying out what is probably the first study on the food habits of the northern elephant seal. According to George Antonelis of the NMFS National Marine Mammal Laboratory, Seattle, Washington, who led a team of six scientists, this species was almost eliminated in the late 1800's, but has recovered to a level of more than 40,000 animals in the U.S. alone.

Current estimates of food consumption by these animals in the California Current are over 300,000 tons and may be as high as 800,000 tons. This compares with a commercial take on the order of 100,000 tons in 1983. Food habits for this species were previously unknown, except for a few reports on the stomach contents of stranded animals. The commonly-used technique to study the food habits of pinnipeds is to analyze hard parts found in fecal material (scats). This has not worked for elephant seals because the animals feed far enough offshore that most material is passed through the gut before the animals haul out on the beach. In this study, 60 animals were chemically immobilized and their stomachs pumped. Hard parts that were not digested and caught in the stomach lining were recovered.

A preliminary analysis suggests elephant seals eat a large proportion of juvenile hake and squid (no market squid, Loligo, was found, however). The other members of the field party were--from the Southwest Fisheries Center--Dr. Douglas DeMaster, Sandra Hawes, Mark Lowry, and Larry Hansen; from the California Department of Fish and Game, John School; and from the National Marine Mammal Laboratory, Dr. Tom Laughlin.

Marine Sanctuary Program Approves Funding for Second Year of Pinniped Surveys

Mr. Phil Williams, Marine Sanctuary Program, Washington, DC, met with Dr. Douglas DeMaster, Leader of the Coastal Marine Mammal Project, to discuss future funding of pinniped surveys in the northern Channel Islands. A previous contract for $20,000 had recently been completed by Hubbs/Sea World Research Institute. This contract provided for quarterly aerial surveys of pinnipeds on the Sanctuary Islands, and for the analysis and write up of the results. A draft annual report is currently being reviewed. This was the first year for a pilot monitoring program to determine the effect of vessel traffic on the hauling behavior and distribution of pinnipeds. The work was extended for a second year under a $20,000 Memorandum of Understanding between the Sanctuary Program Office and the Southwest Fisheries Center.

Dr. DeMaster also discussed the status of two other contracts that the SWFC has supported with funds from the Marine Sanctuary Program. Under the first contract, a photogrammetric technique is being developed to census pinnipeds on Point Bennet, San Miguel Island and Santa Barbara Island. Lt. Cmdr. Wayne Perryman, NOAA Corps, has been assigned responsibility to direct this study for the SWFC. Perryman will be putting together a paper that compares a series of ground counts of pups with the results from the enumeration of 9 inch imagery, which was taken by Pacific Western Aerial Services. Both California sea lions and elephant seals are being considered in this analysis. It is hoped that aerial surveys can be used to census pinnipeds in areas that are very difficult to survey from the ground or in areas where disturbance is a problem.

Under the second contract, cetaceans that occur around the Sanctuary Islands are being studies. A contract was sublet to Steve Leatherwood, Hubbs/Sea World Research Institute. Leatherwood is assembling an interpretive display for the general public on dolphin identification, a series of slides for use in public presentations, a synthesis of literature for each of the major species in the area, and a set of recordings of underwater vocalizations. Leatherwood expects to complete this project by the end of April 1984.

Joint research and cooperation between the Sanctuary Program and the SWFC have continued since 1981. Funds from the Sanctuary Program have been used to initiate and augment studies on the food habits of pinnipeds on San Miguel Island, to study the hauling pattern of harbor seals on San Miguel and Santa Rosa Island, and to investigate the diving pattern of sea lions and harbor seals at San Miguel Island.

Marine Mammal Data Base Revised and Updated

Biological technicians Alan Jackson and Tom Tumosa report that they recently revised records in the marine mammal sightings data base. Revisions were based on a review of selected marine mammal sighting records coordinated by fishery biologist Dr. William Perrin. The review resulted in a proposed change of species or stock identification to 1445 of these sightings.

It was discovered that data for testis length were missing from numerous records of the male spotted dolphin life history data base (MSPTDB). Although testis lengths have been collected for 3160 specimens, MSPTDB contained these data for only 1481 of these animals. Biological technician Ruth Miller located the missing data which were then added to the data base by biological technicians Al Jackson and Tom Tumosa. Plans are being made to ascertain that all testis length data collected for other dolphin species exist on the appropriate data bases.

Data from the 30 IATTC-observed cruises made last year have been added to the 1983 cruise specifications data base (CS83DB). The cruise specifications data base describes the fishing gear configuration of vessels carrying tuna/dolphin observers. This information can be used to analyze the relationships between vessel characteristics and dolphin mortality. This completes CS83DB with a total of 33 cruises.

Data collected during the December 1983, coastal marine mammal cruise aboard the NOAA Ship David Starr Jordan were edited by Jackson and added to the 1983 research vessel sightings (RS83DB) and effort (RE83DB) data bases. These data included 67 cetacean sightings and 44 hours of cetacean observation effort. RS83DB now contains data for 498 sightings.

Marine Mammal Monitoring and Assessment Program

Data Provided to SW Region

Computer programmer analyst Ken Wallace, programmer Lily Tang, and biological technician Alan Jackson have compiled information based on marine mammal observer data base for use by the Southwest Regional office. The information is being used in studies for preparation of a draft Environmental Impact Statement for new regulations governing the taking of dolphins by the U.S. purse seine fishery for tropical tunas in 1986 and beyond.

Tuna and Billfish Resources

35th Annual Tuna Conference Planned

Dr. Andrew Dizon, Fishery Biologist, reports that the 35th Annual Tuna Conference will be held at the University of California Conference Center at Lake Arrowhead, California, on May 21 to 23 with Dr. Dizon as Chairman. About 75 persons, representing a wide variety of agencies, institutions, and private companies, have made plans to attend.

Twenty-five talks will be presented on a variety of subjects, including the effects of El Niño, the scombrid environment, tuna fisheries and their analysis, biological effects, and future research. After the Conference, abstracts of the talks will be published as an Administrative Report and will be available to those interested.

Albacore Stock Structure Investigated

Oceanographer John Graves reports that he has begun work on an analysis of albacore mitochondrial DNA (mtDNA). The project is divided into two phases: (1) an investigation of genetic differentiation between albacore from different ocean basins, and (2) an analysis of mtDNA variability of albacore taken in the California coastal fishery. For the inter-ocean basin study, samples have been obtained from the U.S. Atlantic coast, South Africa, the mid-Pacific and the California coast. Samples for the study of variability will be obtained from the 1984 California fishery. Results from these studies will be used to determine levels of intra-specific differentiation (stock structure) within the fishery.

Albacore Population Sampling Cruise Planned

Fishery biologist Dave Holts has completed preliminary arrangements for an albacore age sampling experiment. The experiment is designed to sample the age distribution of the albacore population which is the target of the U.S. jig boat fleet. The experiment was originally attempted in 1983, but was unsuccessful due to high winds which hampered retrieval of the sampling gear by the NOAA Ship David Starr Jordan.

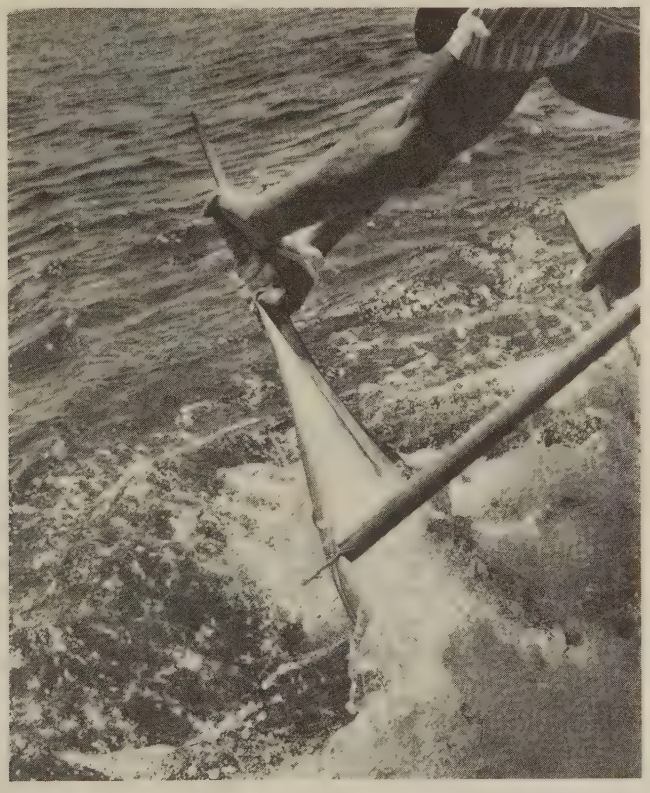
The upcoming August 1984 sampling experiment is being designed and will use a chartered commercial drift gillnet vessel to fish the sampling nets. Scientist aboard the Jordan will take scientific data and observe commercial fishing activity in the immediate vicinity. Use of a commercial fishing boat should reduce problems associated with marginal weather conditions. A request for proposals to charter a commercial vessel will be issued.

1984 Billfish Newsletter in Press

The 1984 edition of the Billfish Newsletter is in press. The Newsletter, which is circulated to sportfishermen, scientists and the interested public throughout the world, has been issued annually since 1964 by the Southwest Fisheries Center's La Jolla Laboratory. Coordinated by fishery biologist James Squire, the Newsletter reviews the activities and findings of the Pacific International Billfish Angler Survey and the results of the Cooperative Marine Game Fish Tagging Program.

Among the interesting results is that tagging of blue marlin was at an all-time record in the northeast Pacific, increasing from 2% of the total billfish tagged in 1982 to 19% in 1983.

The exceptional numbers of blue marlin about the southern tip of Baja California, Mexico, during the El Niño year of 1983 appeared to be responsible for this increase in the number of blue marlin tagged. The effects of the El Niño were also observed in the distribution of striped marlin off southern California. In 1983, 225 marlin were tagged off southern California, an increase from the 40-70 fish tagged in previous years.



Jesus Araiza, Captain of the sportfishing boat, tags a striped marlin off Rancho Buena Vista, Baja California, Mexico.

Data Added to Atlantic Tuna and North Pacific Albacore Data Systems

Al Coan, Program Manager, reports that a partial set of data to be used in the upcoming Working Group on Juvenile Tropical Tunas meeting of the International Commission for the Conservation of Atlantic Tunas (ICCAT) was received and added to the Atlantic tuna data system by computer programmer Christina Show. The data of raised length frequencies represent catches by Atlantic longline fisheries. Data representative of catches by surface fisheries will be added to the data set when they are received. The data will be used to generate analyses which will be presented at the ICCAT meeting to be held in Brest, France, in July.

Revised Japanese longline catch and effort data have been added to the North Pacific albacore data base by computer programmer Christina Show. The data were gathered by fisheries biologist Dr. Norman Bartoo in his recent trip to Japan, and contain all revisions made by the Far Seas Fisheries Research Laboratory from 1952 to 1982. The new data consist of 80,304 records and represent catches and effort for the North Pacific only.

Results of Sampling of 1983 Atlantic Tuna Catch Compiled

Al Coan, Fishery Biologist, reports the following results of sampling catches of tuna in the Atlantic by non U.S. fishermen. Catches are of fish transshipped to Puerto Rico and routinely sampled by biological technician Eugene Holzapfel for length and weight frequency and species composition. Of the 147 samples taken from catches made during 1983, 126 were from the eastern Atlantic (off the coast of Africa) and 21 were from the western Atlantic. Results of the sampling are as follows:

Species and gear	# of samples	# of fish sampled	Tonnage sampled (mt)
Yellowfin			
Purse seine	28	1857	689.8
Baitboat	28	2245	439.8
Longline	1	71	1.1
Unknown	15	1170	191.8
Skipjack			
Purse seine	13	657	5106.8
Baitboat	18	912	1791.6
Unknown	3	151	151.7
Bigeye			
Purse seine	22	731	341.2
Baitboat	2	69	1.0
Unknown	7	193	52.6

Albacore			
Longline	5	250	1463.5
Unknown	3	150	938.2
Blackfin			
Baitboat	2	100	13.3
Bullet tuna			
Purse seine	1	50	180.3

Holzapfel also obtained two yellowfin length frequency samples from transshipments of catches by French seiners fishing in the Indian Ocean.

During the period from January 1 to December 31, 1983, 26 size composition samples were collected for the Multi-species Data Management and Fisheries Monitoring Program by the Inter-American Tropical Tuna Commission. These data were collected from seven foreign purse seiners that fished in the Caribbean Sea and transshipped their catches to Puerto Rico. A summary of these data follows:

Species	Trips sampled	# of samples	# of fish sampled
Yellowfin	7	10	500
Skipjack	7	9	452
Blackfin	4	4	119
Bigeye	2	2	6
Albacore	1	1	18

Report Prepared on the Socio-Economic Aspects of Southern California Billfish Angling

A manuscript entitled "Socio-economic profile of the southern California billfish angler" has been completed by industry economist Sam Herrick. The report presents results from an intercept survey conducted in 1982 that obtained demographic, economic and fishing trip satisfaction data from a sample of anglers who had just completed a southern California (San Diego to Los Angeles) billfish fishing trip.

According to the survey results the representative southern California billfish angler is a 45-year-old male with almost 14 years billfish angling experience, who makes 14 billfish trips annually off southern California and catches approximately three billfish. He pursues a livelihood that earns him in excess of $35,000 annually. The typical billfish angler has almost $1,700 invested in saltwater angling equipment, and spends approximately $74 for fuel, $15 for food and beverages, $15 for gear, $2 for bait and $16 for miscellaneous items on each billfish angling trip he takes. He relates the degree of trip satisfaction to the number of fish caught.

PACIFIC ENVIRONMENTAL GROUP

Regional Variations of Northern Anchovy Studied

Fishery biologist Richard H. Parrish and statistician Donna L. Mallicoate of the Pacific Environmental Group and marine biologist Ken F. Mais of the California Department of Fish and Game have completed a paper entitled, "Regional variations in the growth and age composition of northern anchovy (Engraulis mordax)." This paper is based on data from 4166 midwater trawl hauls and was carried out by the California Department of Fish and Game's Sea Survey Program. The data cover 101 cruises from 1966 through 1983. There were 60,082 anchovies sampled, of which 20,772 were aged.

Growth of northern anchovy is essentially linear after approximately age 1-1/2. Therefore, regression analyses of fish age 1-1/2 and older can be used to assess adult growth (the slope of the regression) and juvenile growth (the size at age 1-1/2). The linear regressions show that juvenile growth is highly regionally dependent (Figure 1). The analyses suggest that juvenile growth has both a latitudinal gradient and an inshore/offshore gradient. Juvenile growth is greatest in central California and offshore in the Southern California Bight. There is essentially no growth after age 1-1/2 in southern Baja California where the southern stock of northern anchovy occurs.

Age composition had significant regional variation; young-of-the-year and one-year-old fish were dominant in Baja California, one- and two-year olds were dominant in the inshore areas of the Southern California Bight, and three-year old and older fish were dominant in the offshore areas of the Southern California Bight and in central California. Age composition was also heavily dependent on depth (Figure 2). For example, young-of-the-year anchovies made up over 50% of the anchovies taken in water less than 25 fathoms in depth. The percentage of young-of-the-year fish dropped off rapidly with increasing depth. Older anchovies, i.e., 3 to 6 year olds, made up a small percentage of the anchovies in shallow water, although they were dominant in deep water areas.

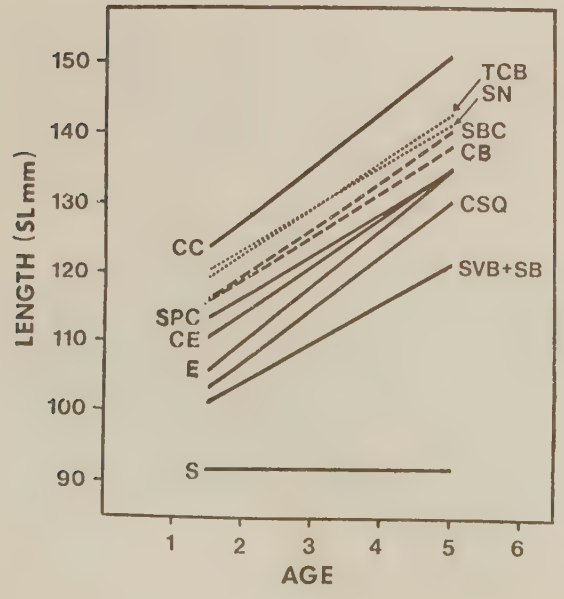


Figure 1

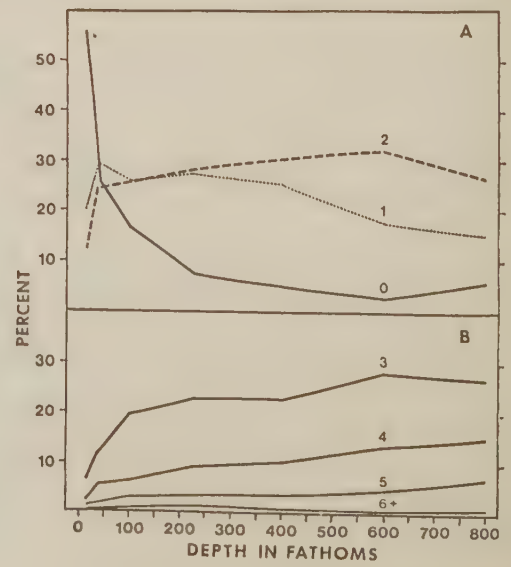
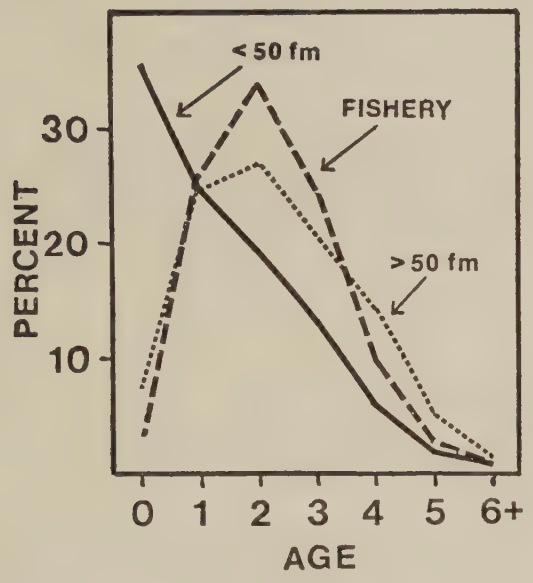


Figure 2

Age composition in the southern California anchovy reduction fishery (1966-1979) has been dominated by one-, two-, and three-year-old anchovies; two-year-olds are the most numerous in the catch (Figure 3). The small proportion of young-of-the-year, and to a lesser degree, the relatively small proportion of one-year olds present in the catch could be caused by either the five-inch minimum size limit or the closures of inshore areas to the reduction fishery. The size limit has been removed, but the area closures are still in force. To approximate the age composition of anchovies in the inshore areas closed to the reduction fishery and in the area where the fishery occurs the sea survey data were grouped into areas less than and greater than 50 fathoms. The age composition of the less than 50 fathom group was very dissimilar to that of the fishery, whereas the greater than 50 fathom group was nearly the same as that of the fishery. This suggests that the fishery will continue to catch only a small proportion of young-of-the-year fish.



The principal findings of the study are as follows: 1. Anchovies have large regional variations in growth during their juvenile phase. 2. Regional variation in adult growth is small, but statistically significant. 3. Age composition of anchovies has considerable regional variation and is also dependent upon depth. 4. The commercial fishery has been heavily affected by regulations which did not take the first three findings into account.

TIBURON LABORATORY

Underutilized Fishery Resources

Staff Members Prepare for Exploratory Fishing Cruise

Fishery biologists Bill Leet, Sennen Salapare and Sus Kato spent the month preparing for a cruise on the NOAA Ship David Starr Jordan, which departs from San Diego on May 3. Experimental fishing gear which will be tried during the 8-day cruise includes a new type of octopus pot, bottom longline for halibut, off-bottom longline for ocean whitefish and rockfish, snail trap, Hawaiian fish trap, and commercial shrimp tags. Fishing trials will be conducted near the northern Channel Islands as well as at 60-Mile Bank off San Diego. During the cruise, a fish aggregating device (FAD), which was deployed at the Bank last May, will be repaired. Vandals destroyed the signal light and also cut off the secondary buoy which holds the attracting devices.

A previous cruise yielded appreciable numbers of octopus, whitefish and neptunid snails. The present cruise will test whether commercial quantities can be taken with the experimental gear during this particular season. A second objective is to ascertain whether methods other than gillnetting are effective for catching halibut and other species.

Fish Communities Investigation

Krill Swarm off Central California Linked to Successful Salmon Fishing

Extensive rust-colored "swarms" of euphausiids appeared at the surface offshore from San Francisco--a phenomenon that occurs most years, though sporadically, off central and northern California from April to June. As in the past, intensive fishing for king salmon (Oncorhynchus tshawytscha) developed in the vicinity of these swarms. Study of this relationship has been an activity of the Staff of the Tiburon Laboratory's Predator-Prey Task, which is studying the basis of seasonal changes in the diets of coastal predatory fishes. This study has shown that the king salmon switches its diet seasonally among anchovies, juvenile rockfishes and euphausiids, depending on their availability. Current work focuses on learning more about the distribution and seasonal dynamics of these forage species as a means to predict the occurrences of the king salmon.

The relationship of swarming behavior in euphausiids to the distribution and behavior of coastal predatory fishes, including the king salmon and various groundfish species, is under study by fishery biologist Susan Smith. With help from the crew of the local party boat Salty Lady, Smith and biological aid Wayne Samiere obtained specimens from these euphausiids swarms

for the first time. All euphausiids in the sample (N=41) were found to be reproductively mature Thysanoessa spinifera with a male:female ratio of 1:7. The species, stage of maturity and sex ratio are similar to those frequently observed in the chinook salmon gut contents at this time of year, and confirms the link between the swarms and salmon predation. Certain groundfish species are also known to feed heavily on T. spinifera, even in areas where the other common California euphausiids, Euphausia pacifica, are generally more abundant. Thus it is possible that the greater predation on T. spinifera may relate seasonally to its swarming behavior. During last year's El Niño conditions no sightings of euphausiid swarms were reported, and euphausiids, normally a dietary staple at that time of year, were absent from the gut contents of king salmon sampled from the local party boats.

Seasonality of Reproduction in Rockfishes Varies

Rockfishes exhibit seasonal variability in their reproductive processes. This phenomenon, which is clearly evident during the months of larval extrusion, has been under study since 1980 by Tina Echeverria, Fishery Biologist with the Groundfish Analysis Task. She has found that the months of larval extrusion, including the peak month, vary from year to year.

The months of larval extrusion in the three major species of Sebastes in the northern California commercial fishery--S. entomelas (widow rockfish), S. goodei (chilipepper), and S. paucispinis (bocaccio)--are shown in Figure 1.

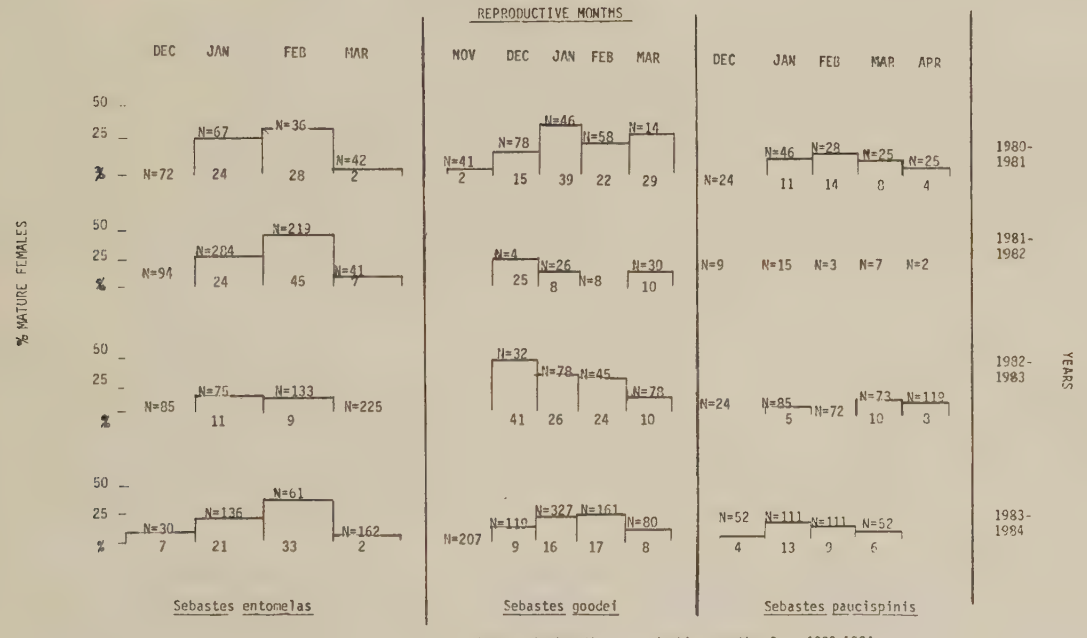


Fig. Percent of mature female rockfish with eyed-larvae during the reproductive months from 1980-1984.

Although reproductive seasonality was investigated throughout the year, the figure shows only the months when eyed larvae occurred. For each month in a reproductive season, the total number (N) of mature females is indicated for each month that eyed larvae occurred. The histogram represents the percentage of the mature females that contained eyed larvae in a particular month. Note

that "good" or "bad" years were not the same for all members of the genus. The interspecific variability in response to the recent El Niño, 1982-83, was particularly noteworthy. While this was a particularly low reproductive year for S. entomelas, it was a high reproductive year for S. goodei.

The relatively low number of S. paucispinis represented in Figure 1 resulted from the low number of mature females of this species that were landed by the fishery. The reason for this remains unknown.

These data are valuable in several ways. They will help in the difficult task of identifying juvenile rockfishes in attempting to predict year-class strength. Thus, if we know that two similar species extrude their larvae during different months it may be possible to distinguish them based on their stages of development. Data from the relative percentage of reproductive females will also be useful when investigating a possible correlation between a "good" reproductive year and a strong juvenile year class. By comparing the reproductive population with larval and juvenile survival, insight into the relative importance to recruitment of these life history stages can be gained.

FISHERIES INFORMATION SYSTEMS & AUTOMATIC DATA PROCESSING

Shipboard Requirements Committee Meets

On April 4, the members of the Shipboard Requirements Committee, Rich Charter and Ron Lynn from CFRD, Al Coan and Wes Parks from OFRD, Susan Iacometti and Dorothy Roll, Chairperson, ADP Operations met with Mike Webb, Electronics Engineer from Naval Ocean Systems (NOS), Seattle, Washington. Webb gave a progress report on the input of the data collection sensors into the CAMAC and the interface of the CAMAC with the Molecular Super-microcomputer 15-8. The CAMAC is the electronics data collection system developed and maintained by NOS. Eight of the ten existing sensors on the NOAA Ship David Starr Jordan are now implemented and the CAMAC has been interfaced with the Molecular Super-microcomputer 15-8. Information on the CAMAC can now be captured by the supermicro for storage on the floppy disk.

The committee reconvened on April 25 with Fred Kellenberger, Data Systems Manager, to dicuss the plans for designing and implementing the data collection software for the shipboard Molecular System. Susan Iacometti, Al Coan, and Rich Charter were designated subcommittee members to design a system for approval by the committee. The plan is scheduled to be completed in June 1984.

Full Implementation Financial Reporting System Delayed

During the first week of April, Robert Nydam, Programmer Analyst, generated the March Financial Reporting System summaries and the CYOP report. However, full implementation of the system on the Molecular Super-microcomputer 32X has been delayed due to hardware/operating system problems on the Super-microcomputer. When random errors occurred under multi-user mode, the system could be recovered only by non-standard procedure.

Other ADP Activities

A CALFIN meeting was held in San Francisco on April 16 to discuss the progress of the CALFIN project. Several members of the staff of the Southwest Region, Southwest Fisheries Center and California Department of Fish and Game attended the one-day meeting.

Susan Iacometti, Computer Systems Programmer, met with Dan Huppert to review the status of the PACFIN system in reference to current data files and the receipt of 1982 data from the Western States for update to the system. She is assisting Andy Bindman, the Statistician in Dan Huppert's program, with data transfers and tape handling of the UCSD VAX system. In addition, she debugged the job stream log for generating a CALFIN report for the Southwest Region and mailed the report to Melva Washington in the Terminal Island office.

ADMINISTRATIVE ACTIVITIES

Update on the A-76 Review

On March 30, 1984, the Center A-76 Review Team met with representatives from Arthur Young & Company, the NOAA contractor performing the OMB Circular A-76 review of ADP services. Arthur Young representatives prepared a draft management efficiency study (MES), which was given to the Center on March 26, 1984. The Center then provided Arthur Young with 96 questions before evaluating the Draft MES. Arthur Young responded to those questions on April 17.

The Center reviewed the Draft MES, and, upon receipt of the Arthur Young response to the 96 questions, prepared comments on the Draft MES concerning problems and proposed changes to the Draft MES. These comments were sent to Arthur Young on May 2, 1984.

MISCELLANEOUS

Kewalo Research Facility Celebrates 25 Years of Research on Tropical Tunas

The Kewalo Research Facility celebrated its 25th anniversary in 1983. This facility, which is part of the Southwest Fisheries Center's Honolulu Laboratory, is devoted to research on physiology, and behavior of tropical tunas. It is the only laboratory in the world that routinely maintains live tunas in captivity for scientific research. The uniqueness of this facility has attracted scientists from Japan, France, the Soviet Union, New Zealand, Australia, Israel, Soviet Union, Canada, and Scotland (Figure 1).

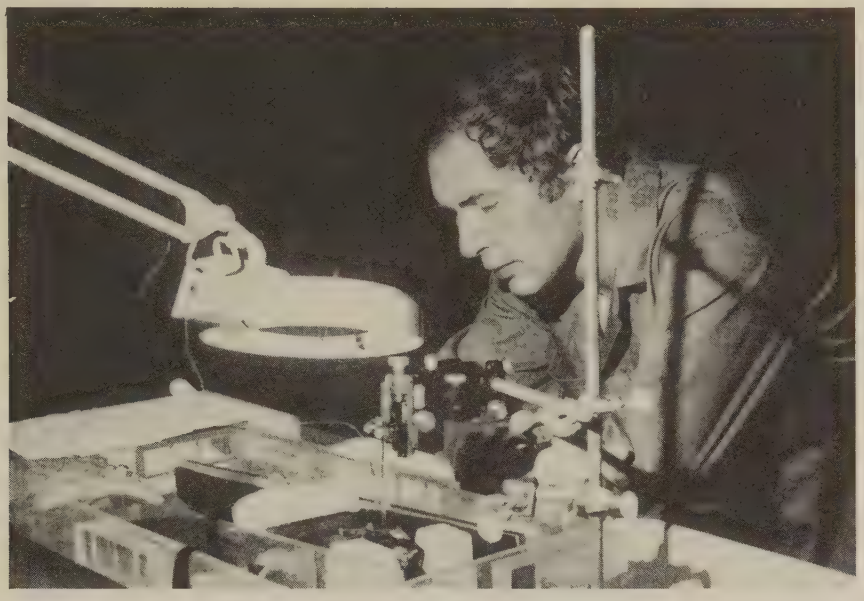


Figure 1. Dr. Sergey Kashin, Institute of Oceanology, Academy of Sciences, Moscow, conducted a study of the neutral control of swimming activity in skipjack tuna at the Facility.

The Kewalo Research Facility located on the Kewalo Basin on the island of Oahu, was established in July 1958 by the Honolulu Laboratory. In the main building are offices, laboratories tailored for specific research activities, a machine shop, and storage areas.

The facility was initially established for the purpose of developing a program to maintain live tunas in captivity for experimental purposes. At the time, little information on live tunas was available. Early research concentrated on collecting data that would serve as a basis for future studies. From this early work came some interesting facts about tunas. It was found that tunas are heavier than water and must continuously swim to keep from sinking. Tunas breathe by simply opening their mouths so that water is

forced over their gills as they swim. The basal swimming speed of tunas is dependent on the lifting area of fins and the density of the fish.

Early studies directed by Dr. John Magnuson also concentrated on the sensory abilities of tunas. Scientists studied how well tunas were able to see, smell, taste, hear, and sense changes in water temperature. Scientists also studied the behavior and sensory capabilities of tunas for use in designing gear and new fishing methods, and for locating tuna.

In current research at the facility, scientists are trying to elucidate the mechanism(s) which permits tuna to maintain high swimming speeds. In a study on the physiological reactions of tunas to exhausting exercise by Drs. Peter Hochachka, University of British Columbia, Tom Moon, Huntsman Marine Laboratory, and Richard Brill, SWFC Honolulu Laboratory, skipjack tuna were exercised to exhaustion and were then anesthetized. The dorsal aorta and sinus venosus were cannulated to sample arterial and venous blood simultaneously in order to determine blood lactate levels (Figure 2).

Figure 2. The dorsal aorta and sinus venosus of an anesthetized skipjack tuna have been cannulated to permit simultaneous sampling of arterial and venous blood for determination of blood lactate levels.

Results showed that a tuna's vascular "heat" exchanger can also serve as a lactate exchange system which permits these fish to recover very rapidly after periods of exhausting activity.

Studies are also being conducted on the ability of tunas to detect changes in the earth's magnetic field and to navigate using a magnetic compass sense. Tunas are highly migratory fish, so scientists are trying to find the special abilities that have evolved in tunas to guide them in their migrations.

Dr. Michael Walker, formerly a graduate student at the University of Hawaii, trained yellowfin tunas to swim repeatedly through a hoop for a food reward. The magnetic field was altered by wrapping the tank with a coil of copper wire (Figure 3).

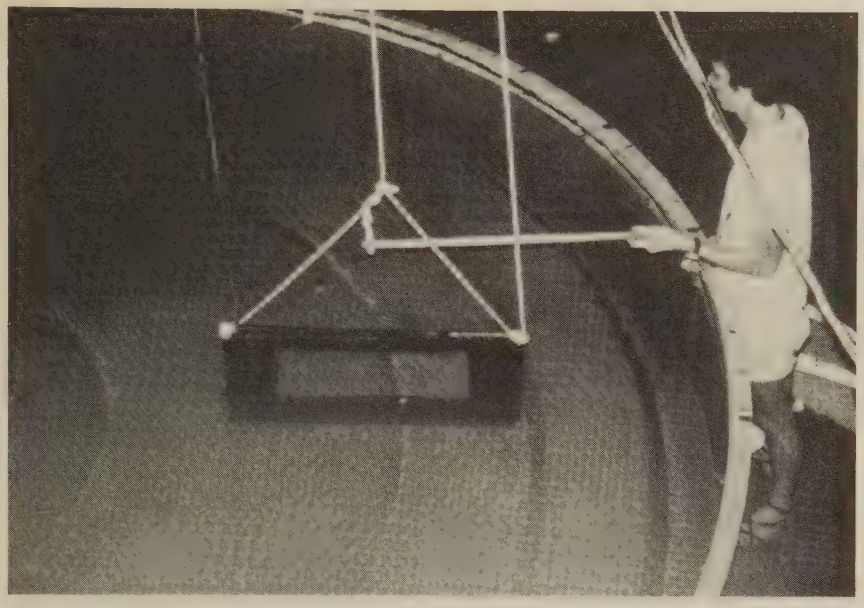


Figure 3. Dr. Michael Walker prepares a tank for his study on the tuna's ability to detect changes in the earth's magnetic field.

The fish were rewarded with food when one magnetic field was present and punished by withholding food when the second field was present. If the fish were able to detect the difference between the two magnetic fields, they would maintain a high rate of response during the trials when food was rewarded, and maintain a low level of response during the trials when food was withheld. The study clearly demonstrated that yellowfin tuna do possess a magnetic sense.

The Kewalo Research Facility uses the Kaahele'ale, a 33-ft research vessel equipped with sophisticated electronic and navigational equipment for tracking the vertical and horizontal movements of tunas and billfishes carrying ultrasonic transmitters.

Honors and Awards

Honolulu Laboratory

William G. Gilmartin, Leader, Marine Mammal and Endangered Species Program, was nominated for the Federal Manager of the Year award, and research assistant Michael P. Seki, for the Federal Employee of the Year award by the Honolulu Laboratory for the 28th annual Federal Day in Hawaii observance.

Employees nominated by Federal agencies belonging to the Honolulu-Pacific Federal Executive Board annually compete for awards in various categories. This year's winners will be announced at a luncheon in June at the Waikiki-Sheraton Hotel.

Honolulu Laboratory Scientists Win Honorable Mention Recognition for Publications

In letters dated March 27, 1984, word was received from William G. Gordon, Assistant Administrator for Fisheries, that Honorable Mention Recognition was given to a paper, "Analysis of double-tagging experiments," by Dr. Jerry A. Wetherall, and "A multispecies analysis of the commercial deep-sea handline fishery in Hawaii," by Dr. Stephen Ralston and Dr. Jeffrey J. Polovina by the NMFS Publications Advisory Committee. The papers were nominated by the Honolulu Laboratory for the "best publication appearing in a 1982 issue of the Fishery Bulletin." Dr. Barrett presented the congratulatory letters to Drs. Wetherall and Ralston at a general staff meeting on April 23.

Public Affairs

Honolulu Laboratory

April 10-11 - Dr. Richard Brill served as a judge at the Hawaii High School Science Fair.

La Jolla Laboratory

April 27 - Dr. Dan Huppert lectured on fishery economics to Dr. Dave Ferris' fisheries class at California State University at San Diego.

Press Release

Honolulu Laboratory

April 12 - "Fishery vessel completes research cruise in the western Pacific."

Seminars

La Jolla Laboratory

April 3 - Dr. Elizabeth Vetter, NOAA Post-Doctoral Fellow at SWFC, La Jolla presented a lecture, "Hydro-thermal ontogeny in a small tropical cetacean: Staying warm in the ETP.

4 - Dr. Mikhail V. Mina, N.K. Koltzov Institute of Developmental Biology, Academy of Sciences of the USSR, Moscow, presented a seminar entitled, "Problems in systematics of the salmonids, with special reference to the genus Brachymystax."

9 - Dr. William Gilmartin, Honolulu Laboratory, presented a talk "A Review of Monk Seal Research by the NMFS."

12 - Sandy Argue, Fisheries Consultant, Lady Smith, B.C., Canada, presented a talk "Cannibalism in skipjack tuna, an evolutionary strategy?"

24 - Gerald Kuhn, Geological Research Division, Scripps Institution of Oceanography, discussed "Short term climatic changes and impact on marine biology."

- Dr. S. Dutt, Head of the Department of Marine Living Resources, Andhra University, Waltair, Disakhatatnam, India, presented a seminar "Management of tropical marine fish stocks."

Visitors

Honolulu Laboratory

April 6 - Dr. Richard Grigg, Hawaii Institute of Marine Biology (HIMB), UH, discussed submersible research programs with Dr. Boehlert.

9 - Dr. Steven T. Zimmerman of Juneau, Alaska, visited Acting Laboratory Director Boehlert.

10 - Dr. Al Atkinson and Dr. Dale Kiefer, consultants to TRW, discussed OTEC biological effects models, particularly as they relate to fisheries, with Richard Uchida and Dr. Boehlert.

17 - Richard Shomura met with Dr. Jack Davidson, UH Sea Grant Program, Dr. Grigg, HIMB, Dr. Boehlert, Richard Uchida, and Dr. Wetherall to discuss possible UH Sea Grant - NMFS research initiatives.

20 - Reginald Gooding met with Terry Kerby of the Hawaii Undersea Research Laboratory staff to discuss the logistics of the proposed Honolulu Laboratory dives in the Makalii at French Frigate Shoals and Brooks Banks.

23 - Dr. Phil Lobel, Harvard University, visited Drs. Boehlert and Ralston to discuss past research at Johnston Atoll and future research plans off the Kona coast of Hawaii.

23-25 - Center Director Barrett was in Honolulu to participate in the Council meeting at the Ala Moana Americana Hotel.

26 - Dr. Laverne Weber, Oregon State University Marine Science Center, met with Drs. Boehlert and Brill to discuss research activities at the KRF.

30 - Mark Clevenger, a writer for Fish Boat Magazine, Fishing News International, and Professional Fishermen (Australia), was given a briefing on the Honolulu Laboratory research program by Richard Shomura.

La Jolla Laboratory

April 3 - Ronda Hageman, Associate Professor of Economics at San Diego State University, San Diego, California, visited the La Jolla Laboratory to confer with Dr. Dan Huppert, Cindy Thomson, and Dr. Sam Herrick regarding research to be carried out during the summer of 1984.

6 - Ms. Ruth Barritt, NOAA's Coordinator for Year of the Ocean, visited Director Barrett at the Center.

12 - Jowdy Johnson, Regional Director, and Mr. Hans Hansen of the DOC Regional Office of the Inspector General, San Francisco, California, met with Izadore Barrett and John Carr at the Center.

19 - Ed Tiernam, NOAA/NESDIS/ORTA, Suitland, Maryland, visited the Center.

20 - Paul M. Wolff, Assistant Administrator for National Ocean Service, Washington, DC, met with Izadore Barrett and John Carr.

30 - Dr. Randall Petermann, Simon Fraser University, Vancouver, BC, Canada, visited the Center.

Pacific Environmental Group

April 12 - Dr. John Hayes, Director, Office of Oceanography and Marine Service, NOS, NOAA, visited the Center.

17 - Dr. Edward V. Tiernan, Director Office of Research and Technology Application visited the Center.

27 - Dr. Valerie Loeb, Moss Landing Marine Laboratories, visited the Center.

30 - Alan Boyd, Sea Fisheries Institute, Capetown, South Africa, arrived to work with Dave Husby and Dick Parrish on cooperative research pertinent to PEG eastern boundary current fishery/environmental comparative studies. Mr. Boyd's visit will extend until June 30.

Tiburon Laboratory

April 6 - Sharon Lundin, Chief Employee Services and Staffing Branch, Western Administrative Support Center, Seattle, Washington, visited the Center.

16 - Edward V. Tiernan, Chief, Research and Technical Applications Unit, National Environmental Satellite, Data and Information Service, NOAA, Washington, DC, visited the Center.

18 - Shelton P. Applegate, University City, Mexico, visited the Center.

Meetings and Travel

Honolulu Laboratory

April 3-5 - Richard S. Shomura traveled to California to participate in the Center Management and Center-Region meetings at Dana Point, California.

- Dr. Robert A. Skillman traveled to Dana Point, California, for a training session on conflict resolution. He also made a presentation on the Fishery Management Research Program during a briefing session at the Center Management Meeting.

5-9 - William G. Gilmartin traveled to California to attend a training session on conflict resolution at Dana Point and to make a presentation on the Marine Mammals and Endangered Species Program at the La Jolla Laboratory.

19 - On behalf of Dr. John Wiltshire of the Hawaii Department of Planning and Economic Development, Richard S. Shomura arranged a meeting with Richard Uchida and Dr. Boehlert, Doyle E. Gates, Western Pacific Program Office, SWR, Kitty Simonds, Western Pacific Regional Fishery Management Council, and Dr. Jack Davidson, Dr. Philip Helfrich, Dr. Lorenz Magaard, Dr. Gary McMurty, and Dr. J. Frisbee Campbell, UH, to discuss a State of Hawaii-Department of the Interior initiative on manganese crust.

23 - Dr. John V. Byrne, NOAA Administrator, spoke to the staff at a general staff meeting. Center Director Izadore Barrett introduced Dr. Byrne who was in Honolulu to present the keynote address at the Pacific Congress on Marine Technology (PCMT) on April 24 at the Princess Kaiulani Hotel.

26 - Richard Shomura chaired the session on artificial reef at the PCMT meeting.

30 - Richard Shomura attended portions of the National Fisheries Institute Convention at the Sheraton-Waikiki Hotel.

La Jolla Laboratory

April 1-5 - Alec MacCall attended a Dahlem Workshop on "Exploitation of Marine Communities in Berlin, GDR and conferred with scientists at FAO headquarters in Rome, Italy.

4-5 - Izadore Barrett, John Carr, Dave Mackett, Reuben Lasker, Gary Sakagawa, Fred Kellenberger, and Ben Remington traveled to Dana Point, California, to attend a Center Management Meeting and a joint Center/Region meeting.

- Dan Huppert, Michael Laurs, Paul Smith, Rennie Holt, Doug DeMaster, Andy Dizon, Tim Smith, and Steve Reilly traveled to Dana Point, California, to attend a training seminar and a joint Center/Region meeting.

4 - Frances Begley attended a training seminar in Dana Point, California.

- Dorothy Roll, Systems Analyst, attended a seminar/workshop on resolving conflict situations" at Dana Point, California.

6 - SWFC/SWR economists (Kevin Carlson, Brian Edwards, Sam Herrick, Dan Huppert, Charles Korson, Wes Silverthorne, Cindy Thomson, and Ed Ueber) met in La Jolla to discuss status of trawl cost-earnings study and usage of PACFIN to monitor the groundfish fleet.

9-11 - Reuben Lasker and Andy Dizon went to Los Angeles, California, to attend a USC Sea Grant Site visit.

10-11 - Izadore Barrett and Dan Huppert attended the Pacific Council's Scientific and Statistical Committee meeting in San Francisco, California.

10-12 - Tim Smith was in Washington, DC, for an ad hoc meeting of U.S. scientific working group on the Antarctic.

11-12 - Reuben Lasker gave an invited lecture to the Department of Oceanography, University of Washington, in Seattle, Washington.

14-17 - William Perrin traveled to San Miguel Island to photograph color patterns of harbor seals, and collect stranded marine mammals.

April 14-
May 14 - Albert Myrick traveled to Moscow, USSR, to conduct joint research on structures in teeth as indicators of the number of young born to a female, using specimens in the Moscow collections.

16 - Dave Mackett and Fred Kellenberger traveled to San Francisco, California, to attend a CALFIN meeting.

18 - Izadore Barrett, John Carr, and Dave Mackett attended a State/Federal Planning meeting in Sacramento, California.

19 - Jeanne Wexler traveled to San Clemente Island, California, to survey sea lions and seals, collect scats and conduct tag resights.

22-25 - Izadore Barrett travelled to Honolulu, Hawaii, to attend the 44th Western Pacific Management Council meeting.

22-25 - Michael Laurs made a presentation on satellite applications to fisheries at the Pacific Conference on Marine Technology.

25 - Doug DeMaster travelled to San Miguel Island to work
May 2 on food habits of elephant seals with the Marine Mammal Commission.

25 - Sandy Hawes and Larry Hansen travelled to San Miguel
May 2 Island to salvage elephant seals, census harbor seals, and collect sea lion scats.

27 - David Au, Al Coan, John Hedgepeth, Rennie Holt, Nancy Lo, Steve Reilly, and Bruce Wahlen traveled to Los Angeles to attend a workshop on "Statistical Computing with Microcomputers," the third annual Workshop on Applied Statistics, UCLA.

30-5/3 - Dave Mackett traveled to Washington, D.C., to attend budget hearings and assist headquarters personnel in budget documentation writing.

Pacific Environmental Group

April 4-6 - Andrew Bakun and David Husby attended the Center/Region Management Meeting at Dana Point.

9-11 - Dick Parrish participated in an Albacore Planning Task Force meeting at Southwest Fisheries Center.

April 4-5 - Pete Adams, Mickey Eldridge, Ted Hobson, Bill Lenarz, and Ed Ueber travelled to Dana Point, California, to attend the Southwest Region/Southwest Center meeting.

4-7 - Sus Kato travelled to Eureka and Crescent City, California, to present workshops on squid fishing at the two port towns.

6 - Ed Ueber met with Southwest Region and Southwest Center economists at La Jolla to determine needs in monitoring groundfish fishery.

10 - Ed Ueber met with Larry Six, Director of the Pacific Marine Fisheries Commission, Portland, Oregon in San Francisco to discuss groundfish trawl logbooks, mesh-size studies and PacFIN price reporting.

12 - Ed Ueber met with Bob Williams of the NMFS Office of Planning, Washington. He arranged for Mr. Williams to meet with industry representatives to discuss NMFS and Pacific Fisheries Management Council policy.

18 - Sus Kato attended a Sea Grant meeting on aquaculture and fisheries at the University of California at Davis.

Personnel

Honolulu Laboratory

April 11 - Yara Lamadrid-Rose, Biological Technician (Fisheries) Full-Time, Temporary Appointment.

15 - Lance S. Asagi, Biological Aid (Fisheries) - Part-Time, Temporary Appointment.

30 - Ellen S. Hayakawa, Computer Clerk - Part-Time, Temporary Appointment.

La Jolla Laboratory

April 1 - Richard Charter, Computer Specialist - Extension of Detail.

1 - George Graham, Clerk Typist - Entered on Duty.

1 - John Jenson, Biological Technician - Entered on Duty.

1 - Lilly Tang, Computer Programmer - Entered on Duty.

1 - Brian Vorndam, Computer Assistant - Extension of Temporary Appointment.

9 - Joseph Joy, Computer Programmer - Entered on Duty.

13 - Douglas Hammond, Computer Clerk - Resignation.

15 - Andrew Bindman, Mathematical Statistician - Entered on Duty.

16 - Marlene Johnson, Junior Fellow - Return to Duty.

- Lisa Lau, Junior Fellow - Return to Duty.

- Roberta Folk, Junior Fellow - Return to Duty.

29 - James Gilpatrick, Biological Technician - Promotion.

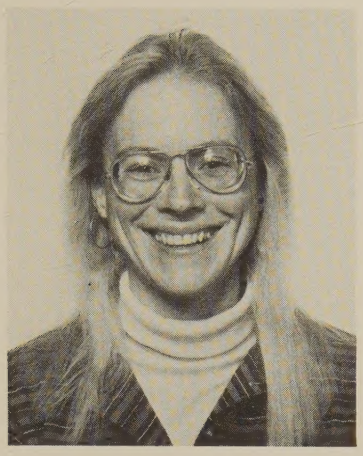
New employees at the Southwest Fisheries Center (shown below in alphabetical order) are:

Andy Bindman
Mathematical Statistician
Coastal Division
Entered on duty: April 15, 1984

Chris Boggs
National Research Council Fellow
Coastal Division
Entered on duty: January 13, 1984

Beverly Macewicz
Biological Technician
Coastal Division
Entered on duty: December 27, 1983

Cynthia Thompson
Industry Economist
Coastal Division
Entered on duty: February 5, 1984



Elizabeth Vetter
National Research Council Fellow
Oceanic Division.
Entered on Duty: October 17, 1983.

Pacific Environmental Group

April 16 - Jerry Norton, Staff Oceanographer

Tiburon Laboratory

April 16 - David Woodbury, Biological Aid - Temporary Appointment.

29 - Susan Logan, Biological Aid - conversion to Student Appointment.

Training

Tiburon Laboratory

April 27 - Maureen Woods, Librarian -BioSciences Seminar, San Francisco Public Library.

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